

# Three new *Halgerda* species (Doridoidea: Nudibranchia: Opisthobranchia) from Guam

by

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*Abstract.* *Halgerda tessellata* (Bergh, 1880) is reported from Guam and Pohnpei within the Micronesian area and three new species of *Halgerda* are described. Two are compared with *H. aurantiomaculata* (Allan, 1932) and *H. terramtuensis* Bertsch & Johnson, 1982, both previously described white tuberculate forms. The third is compared with the type species of the genus, *H. formosa* Bergh, 1880.

## INTRODUCTION

The genus *Halgerda* Bergh, 1880a (= *Dictyodoris* Bergh, 1880b) contains dorids with a somewhat smooth, stiff gelatinous texture with a reticulate pattern of dorsal ridges which may or may not have tubercles at their points of juncture. Recent discussion of the genus can be found in RUDMAN (1978) and WILLAN & BRODIE (1989). Since 1969, 10 species of *Halgerda* have been collected on Guam, including one dredged from 120 m. Six of the species are represented by only one or two specimens in the authors' collection. Of the remaining four, one has been previously described, BERGH (1880b), and three are described in this paper.

## SPECIES DESCRIPTIONS

*Halgerda tessellata* (Bergh, 1880)

(Figures 1-3)

*Dictyodoris tessellata* BERGH, 1880b:75-78, pl. C, figs. 11-12; pl. F, figs. 22-23; ELIOT, 1905:229-230; BURN, 1975:515.

*Halgerda tessellata* (Bergh): RUDMAN, 1978:65-67, figs. 4C-D, 6; WILLAN & COLEMAN, 1984:38-39, 52.

**Distribution:** *Halgerda tessellata* was originally described from Palau (7-8°N, 134°E) in the Western Caroline Islands. *Halgerda tessellata* has also been reported from Australia (BURN, 1975), Madagascar (ELIOT, 1905), and Kenya (RUDMAN, 1978). Since 1969, 87 specimens of *H.*

*tessellata* have been found on Guam (13°N, 145°E) and an additional two on Pohnpei (7°N, 158°E) in the Federated States of Micronesia. The average depth has been 8 m, with the deepest found at 15 m. Two have been found on the reef flat. The largest measured specimen was 33 mm. The records from Guam and Pohnpei extend the range both north and east in the Micronesian area. The only other *Halgerda* recorded with such a wide Indo-Pacific distribution is *H. wasinensis* Eliot, 1904. It has been reported from the Tanzanian-Kenyan area of east Africa (ELIOT, 1904; RUDMAN, 1978) and the Marshall Islands (JOHNSON & BOUCHER, 1983).

**Color:** In most specimens, the body color, as seen from the foot, underside of mantle and mantle margin, varies from yellow to yellow-orange (Figures 1, 2). Except for a broad marginal band, most of the dorsum is covered by dark brown pigment. The brown pigment is less dense over the ridges giving them a mustard yellow to orange-brown appearance. Scattered opaque white dots occur in the depressions between the ridges. These dots become denser toward the outer edge of the brown. Scattered dark brown spots are on the sides of the foot and underside of the mantle. There is also a broad dark brown line on the mid-dorsal part of the tail. The rhinophores are translucent white with a dark brown posterior streak. The lamellae are dark brown. The branchia are white with some of the upper surface of the rachis dark brown. The ridge coloring is not as red as that shown on the color plate in WILLAN & COLEMAN (1984:39, fig. 118). One of the specimens from Pohnpei (Figure 3) had a translucent white rather than yellow body and less of the brown pigment.

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Explanation of Figures 1 to 3

Figures 1-3. *Halgerda tessellata*. Figure 1. 14-mm specimen, Guam, Bile Bay, 14 m depth, 13 June 1971. Figure 2. 23-mm specimen, Guam, Bile Bay, 2 July 1984. Figure 3. 33-mm specimen, Pohnpei, 8 m depth, 17 October 1987.

*Halgerda guahan* Carlson & Hoff, sp. nov.

(Figures 4-9)

*Halgerda graphica* Basedow & Hedley: CARLSON & HOFF, 1973:6, fig. 5 (misidentification).

**Specimens:** Since 1969, 59 specimens of *Halgerda guahan* have been found on Guam. The average depth was 8 m, the maximum 15 m. One specimen was found on the reef flat. The average length of those measured was 43 mm, the longest 64 mm.

**Type material:** Holotype (64 mm), Bishop Museum, Honolulu, BPBM 209916, reef flat, Cetti Bay, Guam, 18 June 1988, Carlson and Hoff. Paratype (47 mm), Bishop Museum, Honolulu, BPBM 209917, 11 m depth, Bile Bay, Guam, 16 March 1991, Carlson and Hoff. Material dissected: 1 specimen, 32 mm, 15 m depth, Agat, Guam, Carlson and Hoff, 21 March 1969; 1 specimen 35 mm, Bile Bay, Guam, Carlson and Hoff, 17 December 1978; 1 specimen 53 mm, 12 m depth, Bile Bay, Guam, Carlson and Hoff, 29 October 1982; 1 specimen, 45 mm, 9 m depth, Bile Bay, Guam, Carlson and Hoff, 16 March 1991. Rad-

ulae of the 35-mm and 45-mm specimens were used for scanning electron microscopy.

**External morphology:** The living animals (Figures 4, 5) are ovate. A 38-mm specimen had a maximum width of 21 mm, others were 46 × 25 mm and 53 × 26 mm. The body has a firm gelatinous texture, as is found in all other members of the genus. It is convex, sloping gradually from the thin mantle margin to the mid-dorsum. The broad, flaring mantle is slightly irregular and usually lies along the substrate when the animal is crawling. The dorsum has a series of low ridges and depressions with no tubercles. A central ridge extends from just in front of the rhinophores almost to the branchia. Two polygonal ridged areas are on either side of this medial ridge and an incomplete polygonal area contains the rhinophores. Other ridges extend transversely from the polygons toward the mantle margin. Shallow depressions occur within each polygon and between the transverse ridges. The ridges have 16 major points of convergence; four along the midline and six on either side. The foot (Figure 6) is a little over one-third of the width of the animal (8 mm for a 21 mm wide



Explanation of Figures 4 and 5

Figures 4, 5. *Halgerda guahan* sp. nov. Figure 4. 32-mm specimen, Guam, Agat Boat Channel, 15 m depth, 21 March 1969. Figure 5. 48-mm specimen, Guam, Anae Island, March 1991.

specimen) and it ends in a rounded tail that is sometimes visible when the animal is crawling. The anterior of the foot has a transverse groove with the upper lamina split in the middle. The oral tentacles are digitiform.

The base of the rhinophores is short and stocky; the club is thin and angled posteriorly. The branchia has four gills; the posterior two being divided about one-third of the way up from the base. The branchial and rhinophoral sheaths are low and simple.

The body is translucent white, almost transparent on the mantle margin. The pinkish brown to purplish brown color of the viscera is visible through the dorsal surface.



Figure 6

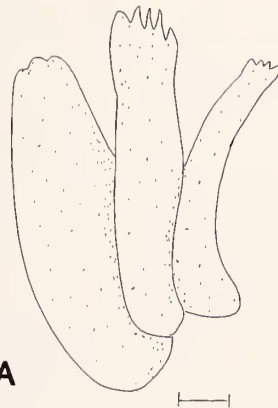
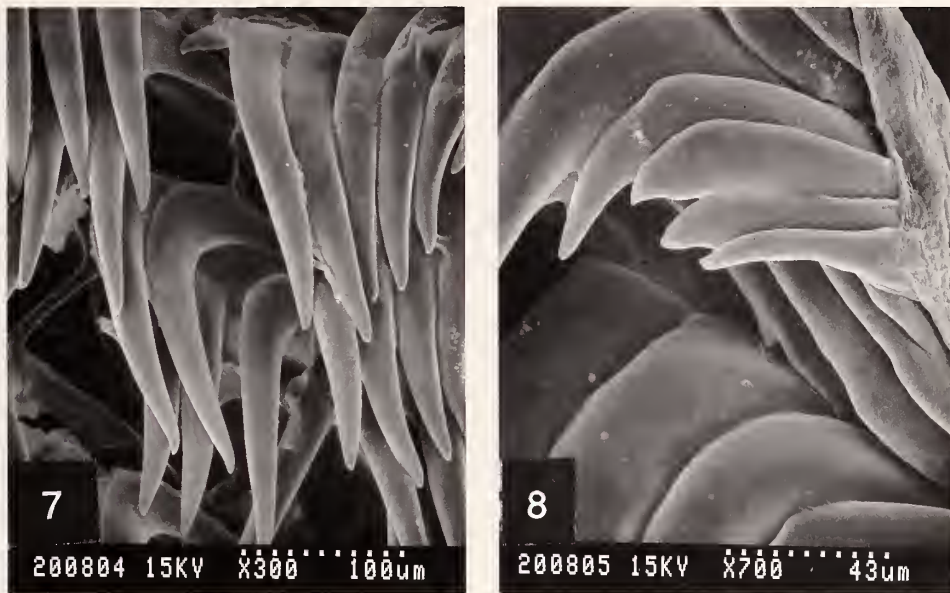
*Halgerda guahan* sp. nov., ventral view, 48-mm living specimen.

The mantle margin is edged by a thin, opaque white line. All ridges are edged in yellow. Single, irregular, curved yellow lines appear within the depressions. No lines extend to the edge of the mantle. The rhinophores are translucent white with brown spots on the base and lamellae. On some specimens the posterior of the rhinophoral base has a broad brown line, which continues as brown streaks on the posterior parts of the lamella. The rhinophoral sheath is edged in yellow. The branchia are translucent with scattered white extending up the rachis and on the tips. Sparse brown spots also appear on the branchia. The branchial sheath is white with yellow lines that extend up from the body. The underside of the body, foot, and oral tentacles are translucent white. Some specimens have a small brown dot between the upper and lower lamina at the anterior of the foot.

Specimens possessing color variations have been found. These variations appear to be the result of damage to the dorsal surface, which causes the yellow lines on the ridges to become broken and irregular.

Specimens preserved in alcohol have retained the brown pigment but not the yellow. In one specimen, which had been fixed in 5% formalin and stored in alcohol for two years, the ridges became pink. It can also be seen on the preserved specimens that the yellow lines within the dorsal depressions actually covered low ridges.

**Internal morphology:** The sac of tissue enclosing the viscera, which appears dark in slides of living specimens, is transparent with brown flecks. With the sac opened dorsally, the large oval stomach, the intestine, the digestive gland mass, and the prostate-covered bursa copulatrix are visible. With the blood gland and nerve ring removed, the white oral tube can be seen curving to join the heavy muscular buccal bulb. With the stomach moved slightly to the right, the broad curved radular sac can be seen extending from the ventral posterior of the buccal bulb. The esophagus exits from the buccal bulb, makes a dorsal



8.A

Figures 7, 8. *Halgerda guahan* sp. nov. Figure 7. Scanning electron micrograph of middle lateral teeth, 45-mm specimen. Figure 8. Scanning electron micrograph of outermost lateral teeth, 45-mm specimen. Figure 8A. Camera lucida drawing of outermost lateral teeth, 32-mm specimen. Scale = 10  $\mu$ m.

loop and enters the stomach ventrally. The intestine exits from the anterior of the stomach and curves around the right side of the digestive gland and continues posteriorly to the anus. From the dorsal view, the top of the brownish prostate-enclosed bursa copulatrix and the albumen/mucous (female) gland complex can be seen to the right and anterior to the stomach. The aorta passes from the blood gland, crosses and is attached to the top of the prostate-covered bursa copulatrix. It continues under the intestine and extends posteriorly to the heart at the anterior base of the branchia.

The radular formulae for 32-mm and 45-mm adult specimens were  $50 \times 49.0\text{-}49$  and  $46 \times 45\text{-}47.0\text{-}45\text{-}47$  respectively. All teeth except the outer three laterals are simply hamate with a flange on the inner edge. In the 32-

mm specimen, the inner 20 teeth were small and gradually increased in size toward the center of the half row (Figure 7). There were 26 large teeth of approximately the same size and then three small outer laterals. The innermost lateral was smaller than the outermost. The scanning electron micrograph shows the outermost laterals to be flattened plates with the outer two having slightly irregular apices (Figure 8). When viewed with a compound microscope the innermost of these three teeth appeared irregular at the apex, the penultimate tooth appeared slightly denticulate, and the outermost was very thin and apically denticulate (Figure 8A).

Within the reproductive system (Figure 9), the hermaphroditic duct connects to the ampulla posterior to the genital mass. The broad ampulla appears as a convoluted,

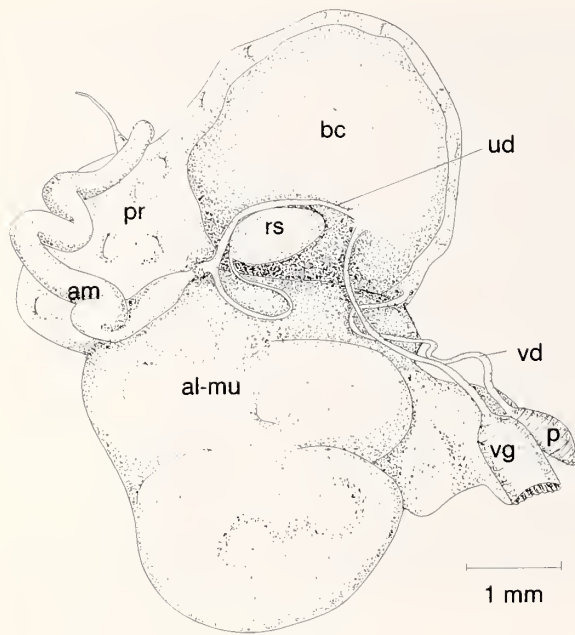


Figure 9

*Halgerda guahan* sp. nov., Reproductive system: al-mu, albumen-mucous gland; am, ampulla; bc, bursa copulatrix; p, penis; pr, prostate; rs, receptaculum seminis; ud, uterine duct; vd, vas deferens; vg, vaginal duct.

somewhat flattened tube at the posterior of the prostate and the albumen/mucous gland complex. It narrows and enters the genital mass at the gland complex, where it joins the prostate gland. The whitish prostate gland ensheathes and folds down under the bursa copulatrix. The actual point of entry of the duct from the ampulla was not observed. A narrow duct arises from the same area, and divides into two ducts; one, the uterine duct, extends for-

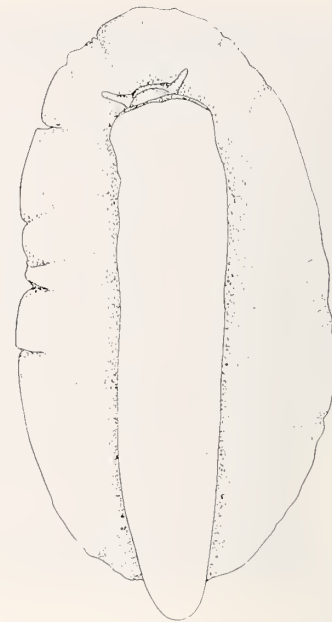


Figure 12

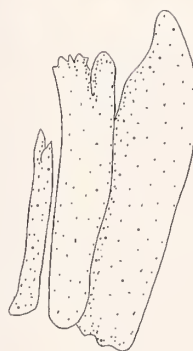
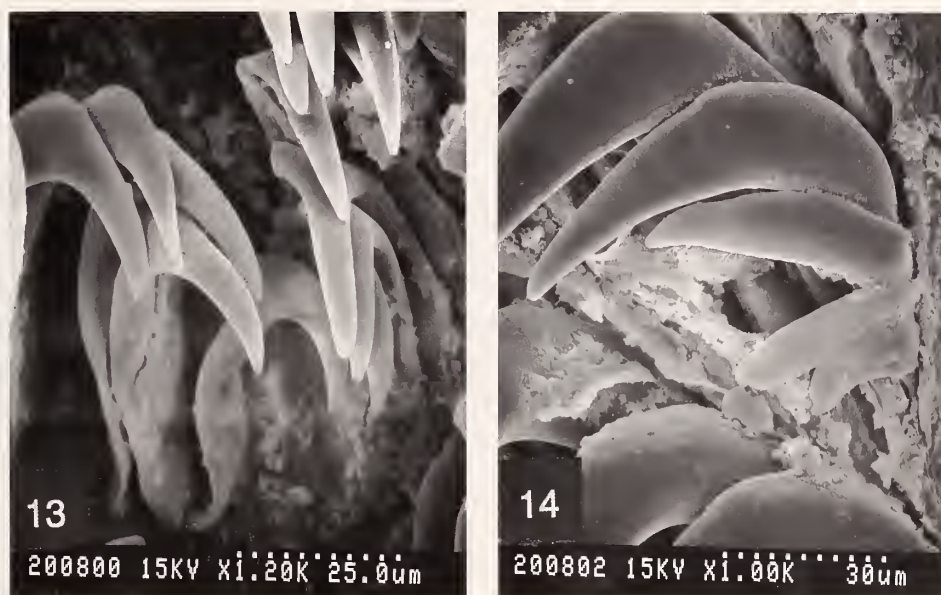
*Halgerda malesso* sp. nov., ventral view, 65-mm living specimen.

ward, where it enters the bursa copulatrix; the other leads to the receptaculum seminis, which is embedded in the prostate gland between the bursa copulatrix and the female gland complex. The long thin tube to the ovoid receptaculum seminis forms a loop along the gland complex and joins the receptaculum seminis posteriorly. Adjacent to the entry of the uterine duct into the bursa copulatrix is the vaginal duct, leading to the vagina which is enclosed in a muscular sheath with the smaller penis. The vagina has a series of longitudinal folds. The long sinuous vas deferens



Explanation of Figures 10 and 11

Figures 10, 11. *Halgerda malesso* sp. nov. Figure 10. 64-mm specimen, Guam, Ana'e Island, 8 m depth, 27 April 1969. Figure 11. 48-mm specimen, Guam, Toguon Bay, 18 m depth, 11 April 1969.



14.A

## Explanation of Figures 13 and 14

Figures 13, 14. *Halgerda malesso* sp. nov. Figure 13. Scanning electron micrograph of innermost lateral teeth, 55-mm specimen. Figure 14. Scanning electron micrograph of outermost lateral teeth, 55-mm specimen. Figure 14A. Camera lucida drawing of outermost lateral teeth, 64-mm specimen. Scale = 10  $\mu$ m.

extends from the small penis to the prostate where it ensheaths the bursa copulatrix. A broad extension from the female gland mass leads to the genital opening, where it terminates in the oviduct. The vagina, penis, and oviduct share a common opening through the body wall.

**Discussion:** *Halgerda guahan* differs from previously described white and orange species of *Halgerda* in that it lacks tubercles, has an uncolored mantle and foot margin, and has a comparatively simple pattern of lines on the dorsum. Internally, the narrow vagina and penial sac enclosed in a muscular sheath differ from the large vagina and large penial sac of both *H. aurantiomaculata* (Allan, 1932) and *H. terramtuensis* Bertsch & Johnson, 1982.

The specific name *guahan* is the Chamorro (*i.e.*, the indigenous people of Guam) name for the island of Guam.

*Halgerda malesso* Carlson & Hoff, sp. nov.

(Figures 10–15)

**Specimens:** Since 1969, 117 specimens of *Halgerda malesso* have been found on Guam and an additional six on the island of Sarigan (17°N, 146°E) in the Northern Mariana Islands. The average depth was 9 m, with the deepest recorded, 18 m. The average length of those measured was 48 mm, the longest was 65 mm.

**Type material:** Holotype (49 mm), Bishop Museum, Honolulu, BPBM 209914, 14 m depth, Bile Bay, Guam, 24 April 1991, Carlson and Hoff. Paratype (65 mm), Bishop Museum, Honolulu, BPBM 209915, 15 m depth, Bile Bay, Guam, 20 April 1991, Carlson and Hoff.

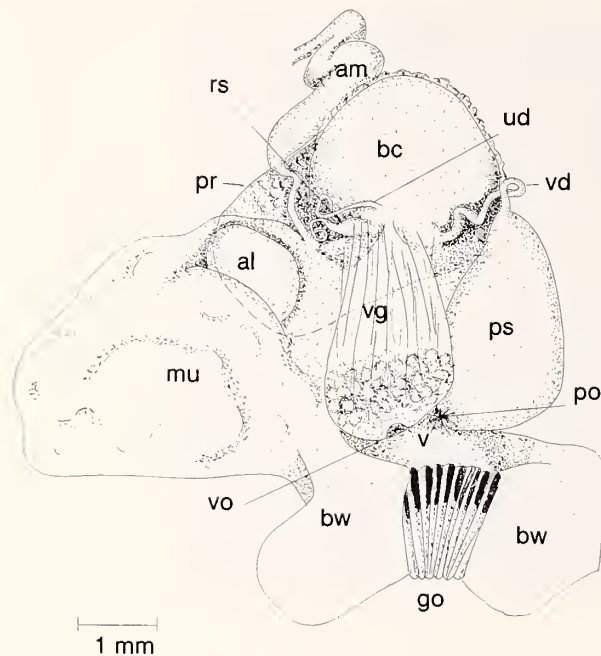


Figure 15

*Halgerda malessio* sp. nov. Reproductive system: al, albumen gland; am, ampulla; bc, bursa copulatrix; bw, body wall; go, genital opening; mu, mucous gland; po, penial opening; pr, prostate; ps, penial sheath; rs, receptaculum seminis; ud, uterine duct; v, vestibule; vd, vas deferens; vg, vagina; vo, vaginal opening.

**Material dissected:** 1 specimen, 64 mm, 8 m depth, Ana'e Island, Guam, Carlson and Hoff, 27 April 1969; 1 specimen 55 mm, 7 m depth, Bile Bay, Guam, Carlson and Hoff, 13 July 1988; 1 specimen, 60 mm, 14 m depth, Bile Bay, Guam, 24 April 1991. Radulae of the 60-mm and 55-mm specimens were used for scanning electron microscopy.

**External morphology:** The living animals (Figures 10, 11) are ovate with a broad, thin, slightly undulating mantle edge. A 55-mm specimen was approximately 30 mm wide at the broadest point. As is true of other species of *Halgerda*, the body texture is gelatinous, smooth, and firm. The dorsum has three distinct, irregular, longitudinal ridges with elevated tubercles and numerous depressions. The median ridge, with the highest tubercles, extends from in front of the rhinophores almost to the branchia. There are four major tubercles on this ridge, one anterior to the rhinophores and three between the rhinophores and branchia. The lateral ridges extend from behind the rhinophores to either side of the branchia. A few tubercles are scattered outside the lateral ridges. The foot (Figure 12) is about one-third of the body width. The anterior end is grooved with the upper lamina split. The rounded tail is sometimes visible when an animal is crawling. Oral tentacles appear short and rounded when an animal is at rest; digitiform when crawling.

The rhinophores are long and tapering, with the club

angling posteriorly. The club and base are about equal in length. The branchia has four gills with numerous large pinnae. In one specimen the posterior two gills were split about two-thirds of the way up from the base. The branchial and rhinophore sheaths are low and smooth. The anus is long and thin.

The body is translucent white with numerous irregular networks of orange lines extending over most of the dorsal surface. These networks are most predominant in the depressions adjacent to the mid-dorsal ridge, where they may fuse, creating pale patches of orange. They may or may not join between depressions. The mantle margin is translucent white with two fine submarginal orange lines. Often these lines attach to the lines on the higher part of the dorsum. The apex of the tubercles is orange. The orange lines on the body do not extend to the tips of the tubercles, thus leaving an unpigmented area surrounding the orange tips. The rhinophores are translucent white with brown spots, brown lamella, and white tips. The branchia is translucent white with brown spots and white tipped brown pinnules. The anus is light brown with darker brown spots and a white tip. The foot is white, rimmed in orange. The oral tentacles have an orange tip. The orange lines toward the edge of the dorsum can be seen from below.

Specimens preserved in alcohol are whitish and have retained the brown pigment on the rhinophores and branchia. A recently preserved specimen retained some yellow on the largest tubercles. In some areas, fine white lines occur where there were orange lines in the living specimen. This is especially noticeable of the submarginal orange lines.

**Internal morphology:** The internal anatomy appears to be the same as that of *Halgerda guahan*, as well as having the transparent visceral sac with sparse brown flecks.

The radular formulae for 64-mm and 55-mm adult specimens were  $67 \times 61.0.61$  and  $51 \times 71.0.71$  respectively. All teeth except the outer three laterals are simply hamate, with a flange on the inner edge. The half row has very small inner teeth (Figure 13) gradually increasing in size toward the center and decreasing toward the outer laterals. The innermost tooth is larger than the outermost lateral. A scanning electron micrograph (Figure 14) of the 55-mm specimen revealed that the three outer laterals are flattened plates with irregularities at the apex of the outer two. When viewed with a compound microscope (64-mm specimen), the innermost of these was smooth; the penultimate was denticulate with one large thumblike denticle on the inner edge and four to five denticles along the apex; the outermost appeared bifid (Figure 14A).

The general arrangement of the genital system (Figure 15) is the same as that described for *Halgerda guahan*, but it differs in detail. The hermaphroditic duct connects to the ampulla posterior to the genital mass. The broad ampulla appears as a convoluted, somewhat flattened tube at the posterior of the prostate and the albumen/mucous gland complex. It narrows and enters the genital mass at



Explanation of Figures 16 and 17

Figures 16, 17. *Halgerda brunneomaculata* sp. nov. Figure 16. 23-mm specimen, Guam, Sella Bay, 4 November 1972. Figure 17. 16-mm specimen, Guam, Cocos Reef, 3 m depth, 13 September 1970.

the gland complex, where it joins the prostate gland. The whitish prostate gland ensheathes, and folds down under, the bursa copulatrix. Two ducts arise adjacent to the area where the ampullar duct enters the genital mass. One, the uterine duct, makes a loop and extends forward, where it enters the bursa copulatrix and the prostate gland. The other long, thin duct forms a loop and extends to the receptaculum seminis, which it joins posteriorly. The receptaculum seminis is embedded in the prostate gland between the bursa copulatrix and the female gland complex and is partially covered by the vaginal duct. The receptaculum seminis is small and ovoid with a narrow distal section. Adjacent to the uterine duct entry into the bursa copulatrix is the vaginal mass. The vagina has a large glandular layer near its opening. The sinuous vas deferens joins the prostate where it covers the bursa copulatrix and extends to the large penial sac, which opens into a common vestibule with the vagina. The penis and vagina are not muscularly connected. A broad extension from the female gland mass leads to the genital opening, where it terminates in the oviduct. The common opening through the body wall for the vagina, penis, and oviduct is lined with dark spotted, longitudinal folds.

**Discussion:** *Halgerda malesso* can be compared with *H. aurantiomaculata* (Allan, 1932) and *H. terramtuentis* Bertsch & Johnson, 1982, both white, orange-marked, tuberculate species. Externally, *H. malesso* lacks the colored mantle margin as well as the color on the ridges between tubercles of these two species. It also differs from *H. terramtuentis* in that the tubercles are capped in orange rather than white. All three species have a large penial sac and glandular structures on the vaginal duct, although the relative shape of the duct varies. WILLAN & BRODIE (1989) described folds in the vagina of *H. aurantiomaculata*, whereas in *H. malesso* folds are found only in the body wall.

The specific name *malesso* is the Chamorro name of the village in southern Guam where most of the specimens have been found.

*Halgerda brunneomaculata*  
Carlson & Hoff, sp. nov.

(Figures 16–21)

**Specimens:** Since 1969, 40 specimens of *Halgerda brunneomaculata* have been found on Guam and two on Sarrigan in the Northern Mariana Islands. All but one specimen were found at a depth of 3 m or greater, the deepest being 21 m. The average length of those measured was 13 mm, the longest was 23 mm.

**Type material:** Holotype (13 mm), Bishop Museum, Honolulu, BPBM 209918, 4 m depth, Bile Bay, Guam, 29

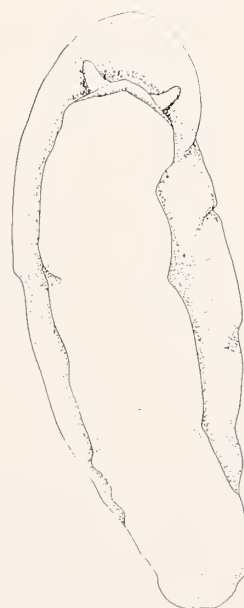
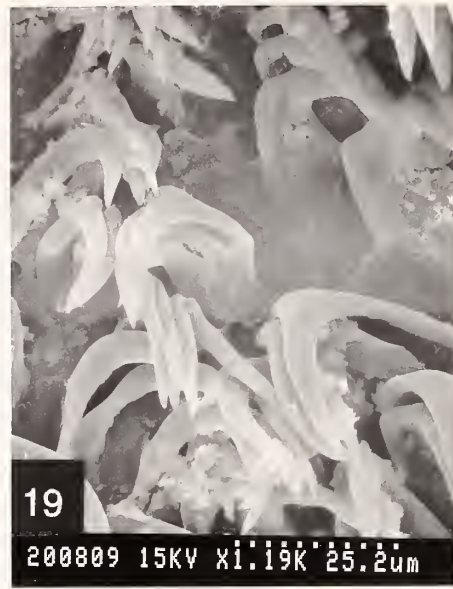


Figure 18

*Halgerda brunneomaculata* sp. nov., ventral view, 13-mm specimen.





Explanation of Figures 19 and 20

Figures 19, 20. *Halgerda brunneomaculata* sp. nov. Figure 19. Scanning electron micrograph of innermost lateral teeth, 23-mm specimen. Figure 20. Camera lucida drawing of outermost lateral teeth, 13-mm specimen. Scale = 10  $\mu$ m.

September 1990, Carlson and Hoff. Paratypes (11, 12 mm) Bishop Museum, Honolulu, BPBM 209919, 9 m depth, Toguon Bay, Guam, 16 April 1972, Carlson and Hoff.

**Material dissected:** 1 specimen, 23 mm, Sella Bay, Guam, Carlson and Hoff, 4 November 1972; 1 specimen, 13 mm, 2 m depth, Bile Bay, Guam, Carlson and Hoff, 11 January 1987; 1 specimen 13 mm, 18 m depth, Bile Bay, Guam, Carlson and Hoff, 27 June 1991. Radulae of 23-mm and 13-mm specimens were used for scanning electron microscopy.

**External morphology (Figures 16, 17):** *H. brunneomaculata* is elongate-ovate. A 16-mm specimen was about 4 mm in width. The dorsum is marked by a pattern of low ridges. The ridges form a series of irregular polygons on either side of the midline, sometimes partially crossing it. The ridges are slightly higher at their points of juncture, but tubercles are not present. The foot (Figure 18) is relatively broad and about two-thirds the width of the animal. As with the preceding two species, the anterior of the foot has a transverse groove. The broad, rounded tail extends beyond the posterior mantle edge. The oral tentacles are digitiform.

The rhinophores are lamellate for approximately half of their length, with the broadest lamellate part being about the same width as the heaviest part of the base. There is a slight conical tip that is most noticeable in smaller specimens. Only one specimen showed posterior angulation of the club. The branchia is made up of four pinnate branches. On one specimen, the tip of the two anterior branches

was divided. Both rhinophores and branchia have a smooth low sheath.

The ground color of *Halgerda brunneomaculata* is a pale translucent yellow. The ridges are marked with a darker opaque yellow, which becomes less intense toward the mantle edge and terminates in a series of dots rather than a solid line. On one 13-mm specimen, the body color was dark yellow, presenting no contrast between the ridge and body color. Most of the depressions formed by the ridges have a single, dark brown spot, although a few specimens have scattered spots. Irregular brown spots occur on the top of the tail and sides of the foot. A line of brown spots occurs at the juncture of the mantle and foot. The viscera, as viewed through the dorsal surface, appears dark in some specimens and light in others. The rhinophores are translucent white with dark brown lateral stripes. The branchia is translucent white with a dark brown stripe on the upper side of the rachis. The rhinophore and branchial sheaths are unmarked.

Specimens preserved in alcohol vary from pale yellow to tan. None of the yellow on the ridges is retained. The brown spots and brown lines on the rhinophores and branchia are retained in some specimens and almost completely lost in others. Some of the brown pigment that is retained comes off easily when the specimen is handled, a characteristic also noted by BASEDOW & HEDLEY (1905:152) in *Halgerda graphica*.

**Internal morphology:** The general arrangement is similar to that described above for *Halgerda guahan* and *H. ma-*

*lesso*, with one major exception. In the preceding two species, the main component of the genital system that is visible when the animals are opened dorsally is the prostate-covered bursa copulatrix. The genital system of *H. brunneomaculata* is twisted about 90 degrees to the left, which hides the bursa copulatrix under part of the female gland mass and digestive and buccal organs, leaving part of the female gland mass visible.

For two 13-mm and one 23-mm adult specimens, the radular formulae were  $37 \times 30-32 \cdot 0 \cdot 30-32$ ,  $48 \times 35 \cdot 0 \cdot 35$ , and  $51 \times 29 \cdot 0 \cdot 29$  respectively. All except the outer five teeth are simply hamate with a flange on the inner edge. In the 13-mm specimen, the inner five teeth (Figure 19) were comparatively small and gradually increased in size. Teeth six through 12 increased rapidly, and then the remaining laterals increased gradually to the largest teeth near the outer end of the half row. The innermost lateral was smaller than the outermost lateral. The outer five teeth (Figure 20) were small, flattened, and apically pectinate. The innermost of these small teeth had a large pectinate denticle on its inner edge. Scanning electron micrographs of the outermost lateral teeth were not successful because the pectinations folded over during dehydration.

As noted above, the genital mass of *Halgerda brunneomaculata*, *in situ*, appears quite different from that of *H. guahan* and *H. malesso* because of the orientation to the left. Otherwise the relationship of the parts of the system is much the same (Figure 21). The small hermaphroditic duct connects to the ampulla ventrally at the posterior of the genital mass. The broad, somewhat flattened, ampulla has a large fold, then narrows before entering the albumen/mucous gland complex. The small uterine duct arises anterior to the entry of the ampullar duct and extends to, and connects with, the bursa copulatrix. The large prostate narrows where it folds over to partially enclose the small bursa copulatrix. The subovoid receptaculum seminis, which is almost as large as the bursa copulatrix, is partially embedded in the prostate on one side and lies against the bursa copulatrix on the other. It is joined to the uterine duct by a short, thin tube. The uterine duct gives the appearance of winding over the surface of the bursa copulatrix and it exits as the vaginal duct, near the area where the narrow part of the prostate folds over the bursa copulatrix. This vaginal duct is quite sinuous and broadens to form the vagina. The sinuous vas deferens exits from the narrowest part of the prostatic fold and leads to the elongate penial sheath, which joins the vagina before reaching the opening through the body wall. A large extension from the female gland mass, the oviduct, is adjacent to the penis and vagina, where the common opening is situated. This opening is lined with longitudinal folds.

**Discussion:** Only one other species of *Halgerda* has been described that has a pale yellow ground color, *H. formosa* Bergh, 1880, the type species of the genus. The original color notes from Dr. Koerbl state, "gelblichweiss mit or-

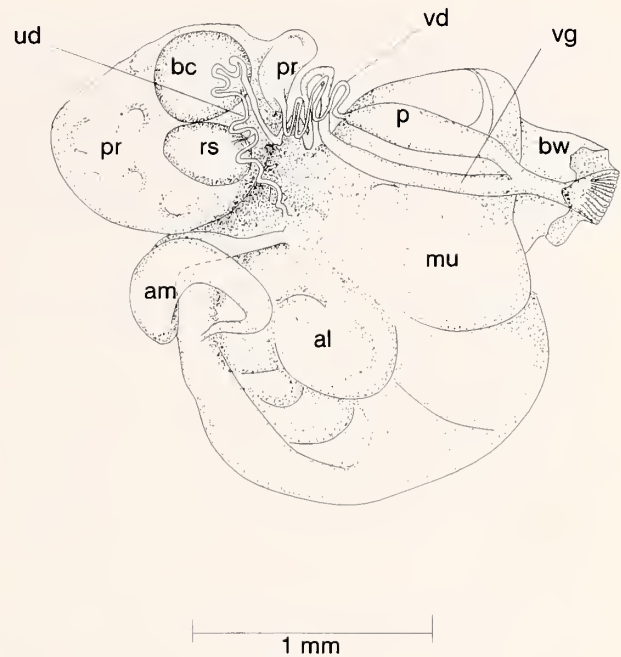


Figure 21

*Halgerda brunneomaculata* sp. nov. Reproductive system: al, albumen gland; am, ampulla; bc, bursa copulatrix; bw, body wall; mu, mucous gland; p, penis; pr, prostate; rs, receptaculum seminis; ud, uterine duct; vd, vas deferens; vg, vagina.

angelegten Streifen und schwarzen Punkten am Rücken, sowie mit schwarzen Rhinophorien" (BERGH, 1880a:191). When Bergh worked on the preserved animal he found only one black spot and also reported a black band on the midline of the tail. We assume that much of the dark pigmentation had been lost in the preserved animal Bergh examined, as is common with many of our specimens. Externally, *H. formosa* and *H. brunneomaculata* appear to be similar in terms of body color, darker ridge coloration, and the presence of dark spots. The main differences are the presence of the dark band on the tail of *H. formosa* and the lack of dark pigmentation on the rhinophoral base. The latter could be from loss of pigmentation in preservative. Internally, Bergh describes a chocolate-brown visceral sac, whereas that for *H. brunneomaculata* is translucent with sparse brown flecks. The oral tube, spotted in *H. formosa*, is unmarked in *H. brunneomaculata*. The number of pectinate laterals is different in the two species: two for *H. formosa* and five for *H. brunneomaculata*. The denticles on the laterals are also much shorter in *H. formosa* than in *H. brunneomaculata*. Bergh described *H. formosa* as having a bladderlike enlarged vagina with longitudinal folds, whereas *H. brunneomaculata* has a narrow vagina and folds are found only in the genital opening through the body wall.

BERGH (1889) described white animals from Mauritius also as *Halgerda formosa*. These animals had yellow ridges

and dark spots. Externally they differed from the 1880 *H. formosa* in basic body color, presence of tubercles, and the absence of a dark band on the tail. At the present time we believe that BERGH's (1889) *H. formosa* is probably a different species.

The name *brunneomaculata* was chosen because of the dark brown spots present on the animal's mantle and body.

### DISCUSSION

In the course of preparing this paper we discovered several elements that we feel should be taken into consideration in further work on the *Halgerda*.

A mid-dorsal pattern with four major points of juncture, one in front of the rhinophores and three between rhinophores and branchia, is found in all three animals described in this paper. This configuration is not always clearly seen in *Halgerda brunneomaculata*. The six undescribed species in our collection have the same pattern. For those species that have a color pattern that does not follow the ridges, the major midline points are most obvious in the preserved specimens. In tuberculate species, the major tubercles arise at the points of juncture.

BERGH (1880b) discussed this pattern for *Halgerda tessellata* as did ALLAN (1932) and WILLAN & BRODIE (1989) for *H. aurantiomaculata*. This same pattern appears in other *Halgerda* species, though generally it is not discussed in the text, but appears in the figures or plates accompanying an article. Some examples are found in BERGH (1905:pl. 2, fig. 4a) for *H. elegans* Bergh, 1905; BERGH (1889:pl. 84, fig. 3) for *H. "formosa"*; BERTSCH & JOHNSON (1981:46-47) for *H. terramtuensis*; ELIOT (1904:pl. 34, fig. 1) and GOSLINER (1987:68, fig. 88) for *H. wasinensis* Eliot, 1904; and LIN (1975:pl. 2, fig. 7) for *H. xishaensis* Lin, 1975.

The three new species described in this paper have a very noticeable flange on the inner edge of all but the outermost lateral teeth. BERGH (1880a) also noticed a flange when he described *Halgerda formosa*, as did WILLAN & BRODIE (1989) in their work on *H. aurantiomaculata*. If the presence of the flange is not recognized, it can cause an interpretation of the teeth that gives a far greater angulation than actually occurs.

The three yellowish *Halgerda* (*H. formosa*, *H. tessellata*, and *H. brunneomaculata*) so far described have pectinate outer laterals. This feature is not limited to the yellowish species because it is also found in *H. elegans* Bergh, 1905, and *H. xishaensis* Lin, 1975. What appears to be unique among the yellow forms is the large denticle that occurs on the inner edge of the innermost of the pectinate teeth.

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